6. ENVIRONMENTAL RESTORATION PROGRAM

6.1 INTRODUCTION

The mission of the DOE Office of Environmental Restoration (EM-40) is to protect human health and the environment from risks posed by inactive and surplus facilities and contaminated areas by remediating sites and facilities in the most cost-efficient and responsible manner possible in order to provide for future beneficial use. These facilities and environmental media contain radioactive and chemically hazardous contaminants as a result of previous activities conducted by DOE and its predecessor agencies.

The environmental restoration program includes a bias for action to expedite actual cleanup wherever and whenever possible. Activities are prioritized based upon several factors, including the need to eliminate risks at sites not controlled by the federal government, the goal of reducing risks at all sites, and compliance with various laws, regulations, and agreements. Most actions are designed to either remove or contain contamination in the environment (such as contaminated soil, debris, and ground water) or to decommission contaminated structures (including reactors, chemical processing buildings, and support facilities). Related activities to support remediation actions include treatment of contaminated materials and wastes, transportation of these materials and wastes to storage and disposal facilities, and disposal of wastes in permitted facilities.

Environmental restoration activities include cleanup of buildings and areas that supported defense-related activities (such as nuclear weapon component fabrication) and nondefense, civilian nuclear power activities (such as the development of heat sources for the space program and the operation of small test reactors). Remedial actions are concerned with all aspects of the assessment and cleanup of inactive sites at which releases of radioactive and chemically hazardous substances have occurred. These actions are not limited to the areas directly impacted by the release but also include additional areas to which contaminants may have migrated (such as to ground water).

Cleanup goals and remedies for each contaminated area are developed through processes established by federal and state laws and other legal agreements. These processes involve decision-makers outside DOE, such as EPA and the impacted state, and include input from other stakeholders such as local citizens and national environmental groups. The principal regulatory requirements for remediation activities are derived from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Activities may be subject further to requirements associated with compliance with the National Environmental Policy Act (NEPA) and with regulatory requirements imposed by the states. Other requirements are set forth in various DOE Orders and standards and in other guidance documents.

Decommissioning activities, which occur after facilities have been stabilized and deactivated, address contamination within the structures. The objectives of decommissioning are to eliminate potential risks to human health and safety and the environment and to allow for the reuse of materials, equipment, and buildings to the greatest extent practicable. Most decommissioning activities are concerned with facilities such as reactors, hot cells, processing plants, storage tanks, and other structures from which, in general, few releases to the environment have occurred.

Decommissioning activities are carried out according to requirements set forth in various DOE Orders and standards and other guidance documents. State requirements also apply in certain instances. Based on a joint policy between DOE and EPA, provisions of CERCLA generally govern decommissioning activities, which are conducted as non-time-critical removal actions. The EM-40 program has placed a priority on minimizing secondary waste and has recycled more than 7,000 metric tons (t) (8,000 tons) of scrap metal from dismantled facilities and equipment.[1] Only those

decommissioning activities at facilities currently in the EM-40 program are addressed in this chapter.

The first steps in the remediation process for contamination in environmental media are to identify the contaminants of concern, determine the extent of contamination, and assess potential threats to human health and the environment. If a significant contamination problem is indicated and if a fast and limited cleanup or containment action could mitigate this problem, DOE may conduct an expedited response action or interim remedial action.

Upon completion of characterization, a detailed analysis of remedial alternatives is conducted. This analysis is followed by a formal decision-making process, possibly including public meetings and a formal public comment period. If the results of the analysis indicate (a) that a contaminated area does not pose a threat to human health or the environment or (b) that a previously completed limited action adequately addressed the contamination condition, a determination that "no further action" is necessary may be made. Such a determination would be made in conjunction with EPA, the host state, and other stakeholders. However, if a threat is deemed to be present, the appropriate action would be identified and implemented.

A wide range of actions can be implemented to address environmental contamination problems at DOE sites. Current and projected land use is a key component in the decision-making process. For example, in-situ remedies that rely on containment of contaminated materials would be appropriate for the large DOE reservations that are projected to remain under the control of the federal government. In contrast, ex-situ remedies in which contaminated materials are exhumed for treatment and disposal at off-site locations would likely be appropriate for small sites destined to be released for unrestricted or industrial (non-DOE) uses. The most appropriate action to be taken at any given area is site-specific and depends on the types of contaminants present, the medium in which they are found, and the likelihood of current or future exposures.

Environmental restoration activities under the auspices of EM-40 are managed in a decentralized manner. That is, much of the responsibility for program implementation rests with the various Operations/Field offices. These offices have the responsibility for determining the appropriate course of action to take at the various contaminated sites and then directing the remediation activities. The locations of the offices responsible for directing the DOE environmental restoration program are shown in Fig. 6.1. A listing of the sites in the EM-40 program is given in Table 6.1.

In general, the offices directing the environmental restoration program in the field are the same offices that directed activities at these sites when facilities were operational. For example, the Chicago Operations Office directs energy research and development activities at Argonne National Laboratory and Brookhaven National Laboratory, and manages the environmental restoration program at these two laboratories.

Over half of the sites in the EM-40 program are managed under the Uranium Mill Tailings Remedial Action Project (UMTRAP) and the Formerly Utilized Sites Remedial Action Program (FUSRAP). UMTRAP consists of two separate projects: UMTRA–Surface, which is managed by the Albuquerque Operations Office and is scheduled for completion in 1999, and UMTRA–Ground Water, which is managed by the Grand Junction Office and is scheduled to continue through 2011. Congress transferred responsibility for FUSRAP to the U.S. Army Corps of Engineers in October 1997. Information on this program is included in this chapter for completeness since this chapter is based on environmental restoration activities as of July 1997.

UMTRAP was authorized in 1978 and involves the stabilization and control of (a) 24 uranium-processing sites and associated vicinity properties located in 10 states and 2 Indian tribal lands and (b) vicinity properties associated with the Edgemont, South Dakota uranium mill site, which was owned by the Tennessee Valley Authority (Fig. 6.2). All of the sites are located in the western United States, except for one in Canonsburg, Pennsylvania. Remedial actions have been completed at 20 of the 24 uranium processing sites. DOE is seeking revocation, at the state's request, of the two sites in North Dakota. Remediation of the remaining two UMTRAP sites is expected to be completed in 1998.[2] In addition to the surface contamination present at these sites (mill tailings, soil, and structures), the ground water can be contaminated with metals (including uranium and radium) and/or nonmetallic constituents associated with the milling process. Ground water is contaminated at all sites, except for the one at Lowman, Idaho.[3] Active remediation of contaminated ground water is expected to be necessary at approximately three sites. The U.S. Nuclear Regulatory Commission (NRC) has approved ground water compliance strategies for two sites (Maybell, Colorado, and Spook, Wyoming). Thus, including Lowman, three UMTRA sites have been closed out in terms of ground water compliance.

Until recently, the Oak Ridge Operations Office was responsible for implementing FUSRAP, which is primarily concerned with the cleanup of sites that were formerly used to support the activities of the Manhattan Engineer District, established for the Manhattan Project,

and the Atomic Energy Commission (AEC). Responsibility for this program was transferred to the U.S. Army Corps of Engineers in October 1997. Private firms and institutions were contracted by the federal government in the early stages of the nation's atomic development program to develop processes and perform research on radioactive materials. The storage and processing of uranium and thorium ores, concentrates, and residues were often involved. Although these sites were cleaned up to formerly acceptable levels, FUSRAP was established in 1974 to identify; reevaluate; and, if necessary, remediate these sites. Most FUSRAP sites are in the eastern half of the country. Currently, 46 sites have been identified in 14 states; 25 of these sites have already been remediated (Fig. 6.3). Remediation of the remaining FUSRAP sites is expected to be completed within the next ten years.

6.2 ENVIRONMENTAL RESTORATION WASTE CHARACTERISTICS

The volumes and types of wastes associated with DOE environmental restoration activities are a direct result of the remedy chosen. Waste associated with remediation of contaminated environmental media would occur only when such media are exhumed. For example, no waste would be produced at a site for which an in-situ remedy was selected, such as capping an area containing contaminated soil. If minimal remedial action were required (e.g., pumping and treating a small pocket of contaminated ground water followed by constructing of lateral barriers to minimize future migration), the site would have relatively small waste volumes. However, if large volumes of contaminated environmental media were removed, treated to provide a more suitable waste form for disposal, and then disposed of in an engineered facility, the site would have very large waste volumes.

Environmental restoration wastes are different from those associated with processing operations in that restoration wastes generally have much lower concentrations of radioactive and chemically hazardous substances. Much of the material requiring remediation is a consequence of past activities (e.g., spills, waste disposal, and environmental releases such as liquid discharges to drainage basins). In addition, operations within structures resulted in the contamination of equipment, walls, and floors from routine material-handling activities and from off-normal incidents such as spills and equipment failure. Decommissioning of these facilities will result in wastes such as wipes, concrete, metal, personal protective clothing, and decontamination solvents that generally have low concentrations of radioactive and chemical contaminants.

Environmental restoration wastes also differ from those resulting from processing operations in that they are generally highly heterogeneous both in physical form and chemical constituency. For example, remediation of an abandoned waste pit could require the exhumation of all materials previously placed into the pit for disposal. This effort could involve any possible combination of objects ranging from small pieces of equipment and drums to entire vehicles such as trucks and forklifts. In addition, a full spectrum of contaminants could be present in these previously disposed materials including those associated with ordnance operations, processing of uranium and thorium ores and concentrates, and the operation of nuclear reactors and associated chemical processing plants. This potential variety is in contrast to waste streams associated with processing activities that have relatively consistent chemical and physical properties.

Because many DOE environmental restoration projects are still in the remedy-selection phase, it is not possible to project definitively the wastes that will result from all of these projects. However, reasonable waste projections can be made based on current site characterization information and planned restoration activities for sites and facilities in the EM-40 program. These estimates are presented in Tables 6.2 through 6.7. In addition to waste projections, the volumes of contaminated materials associated with in-situ remedies are also provided in these tables. These estimates do not include contaminated media outside the scope of the current EM-40 program. Materials in inventory (i.e., those with potential economic value) are also not included in these estimates.

In addition to wastes to be generated, environmental media projected to be left in place have also been assigned a "waste" class in this report. This was done to simplify the tracking of all contaminated materials at the various sites, even though these media are technically not wastes unless or until they are removed. Three major radioactive waste classes are associated with environmental restoration activities: LLW, TRUW, and 11e(2) by-product material. As defined in DOE Order 5820.2A, LLW is waste that contains radioactivity and is not classified as HLW, TRUW, spent nuclear fuel (SNF), or 11e(2) by-product material. Environmental restoration activities are not expected to generate any HLW or SNF, although some sites may have to address previously generated HLW as a component of environmental

restoration activities. TRUW is waste contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and at concentrations greater than 100 nCi/g at the time of assay.

As defined in Section 11e(2) of the Atomic Energy Act (AEA) of 1954 (Pub. L. 83–703, as amended), 11e(2) by-product material is tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Materials being managed under Title 1 of the Uranium Mill Tailings Radiation Control Act of 1978 (Pub. L. 95–604) are defined as residual radioactive material distinct from 11e(2) by-product material. This residual radioactive material is largely uranium mill tailings (UMT), as well as soil and debris contaminated with UMT. Since this material has the same physical and radioactive properties as 11e(2) by-product material, it is included in this report with 11e(2) by-product material.

These radioactive wastes and materials can also be contaminated with hazardous constituents as regulated by RCRA or TSCA; such wastes are considered mixed wastes. Thus, a total of six waste classes are relevant for radioactively contaminated material resulting from environmental restoration activities: LLW, mixed LLW (MLLW), TRUW, mixed TRUW (MTRUW), 11e(2) by-product material, and mixed 11e(2) by-product material.

The EM-40 program is currently in the process of updating contaminated media and waste management information for the DOE/EM 2006 Plan. A key component of this activity is the development of baseline disposition maps summarizing the flow of materials and wastes at each site. These maps will encompass the entire EM-40 program at each site and will include information on the planned disposition of the entire inventory of contaminated media and wastes, including that projected to be managed in-situ, as well as that to be managed ex-situ and will address inter-site transfers of wastes. There will likely be differences between the information contained in this chapter with that in the 2006 Plan due to changing plans and schedules for the EM-40 program attributable to reduced funding for environmental restoration activities.

The estimated volumes of radioactively contaminated materials being managed by the EM-40 program are summarized in Table 6.2. Additional information, including proposed dispositions for these materials, is provided in Tables 6.3 through 6.6 for LLW, MLLW, TRUW, and 11e(2) by-product material, respectively. The volumes given in Table 6.5 for TRUW include the contribution of mixed wastes (the mixed waste volumes are identified in footnotes). No mixed 11e(2) by-product material was reported for any site. The mixed wastes reported in Tables 6.4 and 6.5 are limited to RCRA mixed wastes and do not include the contribution of TSCA mixed wastes. TSCA mixed wastes are reported separately in Table 6.7. In addition, radioactive wastes currently in storage at EM-40 facilities are reported in Table 6.8.

The estimated volumes given in Tables 6.3 through 6.7 are grouped into the following six categories:

1. collection for treatment, storage, and/or disposal by EM-40;
2. collection for treatment, storage, and/or disposal by EM-30;
3. collection for disposition at a commercial facility;
4. in-situ treatment or containment;
5. access/institutional controls or no further action; and
6. not yet determined.

Contaminated materials will be removed and wastes will be generated under the first three categories (ex-situ responses) with responsibility for final disposition either maintained within the EM-40 program, transferred to the EM-30 program, or targeted for a commercial facility. The first category represents wastes projected for on-site disposal (such as the Hanford, Fernald, Monticello, Nevada Test, and Weldon Spring sites) or for which disposal decisions have not been finalized. The second and third categories represent wastes for which specific disposal decisions have been made. Wastes will not be generated under the fourth or fifth category, which will involve such measures as capping, monitoring, and retention of land-use controls. The last category addresses materials for which the final disposition is not currently known.

The estimates represent the initial response volumes, that is, the amount collected, not the final waste forms. Thus, changes due to activities such as treatment have not been incorporated. Treatment can result in higher or lower final volumes depending on the specific process used (e.g., stabilization versus incineration). Treatment can also change the waste class (e.g., stabilizing a MLLW material could result in an LLW product). These changes are not reflected in the information provided in Tables 6.2 through 6.8.

The total volume of solid radioactively contaminated material being address by the EM-40 program is approximately 57 million cubic meters (Table 6.2). An additional 27 million cubic meters of UMTs and debris have already been disposed of at the 20 completed UMTRAP sites. Most of this material (72 vol %) is classified as LLW. Of the material classified as LLW, most (78 vol %) is projected to be managed in-situ. Los Alamos National Laboratory and the Hanford Site account for most of this volume.

The other waste classes combined contribute about 28 vol % of the total volume of radioactively contaminated material being addressed by the EM-40 program. Most of this volume is associated with material currently classified as MLLW and 11e(2) by-product material. The contribution for material classified as TRUW is small, representing less than 1% of the total volume of material being addressed by the EM-40 program. The contribution from TSCA mixed waste is less than 0.1% of the total volume.

As described earlier, remedial actions are currently being conducted at a number of sites. Many of these are small, interim actions. Wastes resulting from these activities are generally being managed at the site where the remedial action occurred. In addition, wastes resulting from remedial actions at some sites (such as those being remediated under FUSRAP) are being managed at commercial disposal facilities.

The information contained in this chapter is limited to radioactively contaminated environmental media and wastes, consistent with the scope of this report. The volume estimates given in Tables 6.2 through 6.8 are also limited to solid materials. Liquids, such as contaminated surface water and ground water and liquid wastes currently in storage, are not included. It should not be concluded that sites for which no (or minimal) volumes are indicated in Tables 6.2 through 6.8 have no waste management concerns. Environmental restoration activities at such sites could generate hazardous wastes as regulated by RCRA and TSCA, as well as large volumes of sanitary and demolition wastes. Also, additional characterization activities at these sites may identify areas of radioactive contamination requiring remediation in the future.

The volumes of radioactively contaminated materials given in Tables 6.2 through 6.8 are limited to those sites and facilities currently in the EM-40 program. These data are summed across all elements of a site in Tables 6.2 through 6.7 including environmental media, wastes currently in storage, and radioactively contaminated materials that could result from future decommissioning activities. Stored wastes are reported separately in Table 6.8. At a number of sites, wastes resulting from EM-40 activities have been transferred to the Office of Waste Management (EM-30) for treatment, storage, and disposal. These wastes are no longer being managed by EM-40 and are therefore not included in this chapter.

The DOE Office of Nuclear Material and Facility Stabilization (EM-60) is responsible for coordinating the transfer of facilities to the Office of Environmental Management (EM). As facilities are transferred to EM, environmental restoration and waste management information will be developed and included in future updates of this report.

6.3 REFERENCES

1. U.S. Department of Energy, Office of Strategic Planning and Analysis, Office of Environmental Management, *The 1996 Baseline Environmental Management Report*, DOE/EM-0290, Washington, D.C. (June 1996).

2. U.S. Department of Energy, Office of Environmental Management, *Environmental Management 1996—Progress and Plans of the Environmental Management Program*, DOE/EM-0317, Washington, D.C. (November 1996).

3. U.S. Department of Energy, Office of Environmental Restoration, Office of Environmental Management, EM-40 Core Database, electronic database accessed in August 1997, Washington, D.C.

Table 6.1. List of sites in the DOE Environmental Restoration Program[a]

Responsible office[b]	Site
Albuquerque	Grand Junction Office Site
	Holloman Air Force Base (completed)
	Kansas City Plant
	Kauai Test Facility (completed)
	Los Alamos National Laboratory
	Lovelace Biomedical and Environmental Research Institute
	Maxey Flats Disposal Site
	Monticello Mill and Vicinity Properties sites
	Oxnard Facility (completed)
	Pagano Salvage Yard (completed)
	Pantex Plant
	Peak Oil Potentially Responsible Party (PRP) (completed)
	Pinellas Plant (responsibility transferred to the EM Office of Site Operations)
	Salton Sea Test Base (completed)
	Sandia National Laboratories/California
	Sandia National Laboratories/New Mexico
	South Valley Superfund Site
	Uranium Mill Tailings Remedial Action Project[c]
Chicago	Ames Laboratory (completed)
	Argonne National Laboratory–East
	Argonne National Laboratory–West
	Brookhaven National Laboratory
	Fermi National Accelerator Laboratory (completed)
	Hallam Site (completed)
	Piqua Site (completed)
	Princeton Plasma Physics Laboratory
	Site A/Plot M (completed)
Idaho	Idaho National Engineering and Environmental Laboratory
Nevada	Nevada Test Site
	Nevada off-site locations[d]
	Tonopah Test Range[e]
Oak Ridge	Center for Energy and Environmental Research
	East Tennessee Technology Park
	Formerly Utilized Sites Remedial Action Program[f]
	Oak Ridge National Laboratory
	Oak Ridge Reservation Off-Site Areas[g]
	Paducah Gaseous Diffusion Plant
	Portsmouth Gaseous Diffusion Plant
	Weldon Spring Site
	Y-12 Plant
Oakland	Energy Technology Engineering Center
	General Atomics Site
	General Electric Vallecitos Nuclear Center
	Laboratory for Energy-Related Health Research
	Lawrence Berkeley National Laboratory
	Lawrence Livermore National Laboratory (Main Site and Site 300)
	Stanford Linear Accelerator Center

Table 6.1 (continued)

Responsible office[b]	Site
Ohio	Battelle Columbus Laboratories (King Avenue and West Jefferson) Fernald Environmental Management Project Mound Plant (responsibility transferred to the EM Office of Site Operations) Reactive Metals, Inc., Site Separations Process Research Unit
Richland	Hanford Site
Rocky Flats	Rocky Flats Environmental Technology Site
Savannah River	Savannah River Site

[a]Obtained from information included in the DOE Environmental Restoration web page (http://www.em.doe.gov/er/opsmap.html) accessed in August 1997.

[b]All of the offices listed here are Operations offices except for Ohio and Rocky Flats (which are Field offices). The locations of these offices are shown in Fig. 6.1.

[c]A listing of sites being addressed under UMTRAP is given in Fig. 6.2.

[d]Consists of Amchitka Island and Project Chariot sites in Alaska, Rio Blanco and Rulison sites in Colorado, Gnome-Coach and Gasbuggy sites in New Mexico, Salmon Site in Mississippi, and Shoal and Central Nevada Test sites in Nevada. Remedial actions at the Project Chariot Site have been completed.

[e]The Tonopah Test Range is located about 50 km (30 miles) northwest of the Nevada Test Site. Environmental restoration activities for the Tonopah Test Range are often reported together with those for the Nevada Test Site.

[f]A listing of sites being addressed under FUSRAP is given in Fig. 6.3. This program was transferred to the U.S. Army Corps of Engineers in October 1997.

[g]Consists of contaminated areas beyond the boundaries of the major Oak Ridge facilities including the Oak Ridge Associated Universities/Institute for Science and Education, Clinch River/Watts Bar Lake, Lower East Fork Poplar Creek, and several small privately owned sites in the area.

Table 6.2. Estimated volume of radioactively contaminated solid materials associated with the environmental restoration program[a]

Site	Volume,[b] m^3					
	LLW	MLLW	TRUW[c]	11e(2) by-product material	TSCA mixed waste	Total
Argonne National Laboratory–East	11,000	140,000				150,000
Argonne National Laboratory–West	750					750
Battelle Columbus Laboratories	11,000	31	370		6	12,000
Brookhaven National Laboratory	90,000	150				90,000
Energy Technology Engineering Center	1,600					1,600
Fernald Site	2,500,000	3,800		11,000		2,500,000
Formerly Utilized Sites Remedial Action Program[d]						
Missouri sites				600,000		600,000
New Jersey sites	40,000	24,000		270,000		340,000
New York sites	29,000	5,100		130,000		170,000[e]
Ohio sites				31,000		31,000
Other sites	14,000			29,000		43,000
General Atomics Site	580	9				590
General Electric Vallecitos Nuclear Center	20		20			40
Grand Junction Office Site	6			7,500	110	7,600
Hanford Site	24,000,000	320	1,900			24,000,000
Idaho National Engineering and Environmental Laboratory	430,000	160,000	370,000			950,000
Laboratory for Energy-Related Health Research	1,400					1,400
Lawrence Berkeley National Laboratory	9,400	42,000				52,000
Los Alamos National Laboratory	9,300,000	500,000	4,400			9,800,000
Lovelace Biomedical and Environmental Research Institute	9,100					9,100
Monticello Mill and Vicinity Properties sites				1,600,000		1,600,000
Mound Plant	120,000				870	120,000
Nevada off-site locations[f]	26,000	11,000				37,000
Nevada Test Site	2,700,000	50				2,700,000
Oak Ridge Reservation[g]	120,000	93,000	32		11,000	220,000
Paducah Gaseous Diffusion Plant	110,000	600	1		3,400	120,000
Pantex Plant	700					700
Portsmouth Gaseous Diffusion Plant	740,000	330,000			4,700	1,100,000
Reactive Metals, Inc., Site	37,000	18			600	38,000
Rocky Flats Environmental Technology Site	110,000	310,000	4,900			430,000

Table 6.2 (continued)

Site	Volume, [b] m^3					
	LLW	MLLW	TRUW[c]	11e(2) by-product material	TSCA mixed waste	Total
Sandia National Laboratories/New Mexico	50,000	4,300	4,000			58,000
Savannah River Site	970,000	6,900,000	130,000			8,000,000
Separations Process Research Unit	15,000		36		2	15,000
Uranium Mill Tailings Remedial Action Project[h]				3,200,000		3,200,000
Weldon Spring Site				1,000,000		1,000,000
Total	41,000,000	8,500,000	520,000	6,900,000	21,000	57,000,000

[a]Information obtained from the EM-40 Core Database (August 1997). Volume estimates include environmental media such as soil, sediment, sludge, and intermixed rubble/debris; stored wastes; and standing structures and equipment. Blank entries mean there are no radioactively contaminated solid materials for the indicated waste class. Additional information including projected dispositions for these materials is provided in Tables 6.3 through 6.7. Stored waste information is given in Table 6.8.

[b]These volume estimates represent the initial response volumes, not final waste forms. Changes in volumes and waste classes due to treatment are not reflected in this table. All values are preliminary and are being updated as site characterization and engineering studies continue. Values are given to two significant figures or the nearest integer (for volumes less than 10 m^3). Some totals may not equal sum of components due to independent rounding.

[c]Includes the contribution of material classified as mixed wastes.

[d]A listing of the sites being addressed under FUSRAP is given in Fig. 6.3. This program was transferred to the U.S. Army Corps of Engineers in October 1997.

[e]Additional 190,000 m^3 of contaminated soil and residues have been disposed of in a containment cell at the Niagara Falls Storage Site (see Table 6.8).

[f]Consists of Amchitka Island and Project Chariot sites in Alaska, Rio Blanco and Rulison sites in Colorado, Gnome-Coach and Gasbuggy sites in New Mexico, Salmon Site in Mississippi, and Shoal and Central Nevada Test sites in Nevada. Remedial actions at the Project Chariot Site have been completed.

[g]Consists of East Tennessee Technology Park, Y-12 Plant, Oak Ridge National Laboratory, and contaminated areas in the vicinity of Oak Ridge, Tennessee, beyond the boundaries of these three facilities.

[h]A listing of the sites being addressed under UMTRAP is given in Fig. 6.2. The volume of mill tailings and debris associated with the 20 sites for which remedial actions have been completed is 27,000,000 m^3 (see Table 6.8).

Table 6.3. Projected disposition of radioactively contaminated solid materials classified as LLW[a]

Site	Response volume,[b] m^3						
	Ex-situ			In-situ treatment/ containment	Access control or no further action	Not yet determined	Total
	Managed by EM-40	Transferred to EM-30	Commercial disposal				
Argonne National Laboratory–East		2,700				8,400	11,000
Argonne National Laboratory–West		140				610	750
Battelle Columbus Laboratories		1,600	9,700				11,000
Brookhaven National Laboratory	44,000	3,000	7,900		35,000[c]		90,000
Energy Technology Engineering Center		1,600					1,600
Fernald Site	1,800,000	180,000	480,000				2,500,000
Formerly Utilized Sites Remedial Action Program[d]							
New Jersey sites	33,000		7,000				40,000
New York sites			380	1,700	27,000		29,000
Other sites			4,200	2,700	6,700		14,000
General Atomics Site	580						580
General Electric Vallecitos Nuclear Center	20						20
Grand Junction Office Site			6				6
Hanford Site	3,900,000[f]	700		20,000,000			24,000,000
Idaho National Engineering and Environmental Laboratory	210,000	150,000		44,000	9,200	17,000	430,000
Laboratory for Energy-Related Health Research		1,400					1,400
Lawrence Berkeley National Laboratory		9,400					9,400
Los Alamos National Laboratory		15,000		200,000	8,900,000	110,000	9,300,000
Lovelace Biomedical and Environmental Research Institute		9,100					9,100
Mound Plant		3,100	120,000				120,000
Nevada off-site locations[g]				26,000			26,000
Nevada Test Site	290,000			820,000	1,600,000		2,700,000
Oak Ridge Reservation[h]	110,000	11,000					120,000
Paducah Gaseous Diffusion Plant	110,000				200		110,000
Pantex Plant	700						700
Portsmouth Gaseous Diffusion Plant	740,000	4,700			1,200		740,000
Reactive Metals, Inc., Site			37,000				37,000
Rocky Flats Environmental Technology Site	95,000	17,000					110,000

Table 6.3. Projected disposition of radioactively contaminated solid materials classified as LLW[a]

Site	Response volume,[b] m^3						
	Ex-situ			In-situ treatment/ containment	Access control or no further action	Not yet determined	Total
	Managed by EM-40	Transferred to EM-30	Commercial disposal				
Sandia National Laboratories/New Mexico		36,000			14,000		50,000
Savannah River Site		430,000		21,000	1,200	520,000	970,000
Separations Process Research Unit			15,000				15,000
Total	7,400,000	870,000	680,000	21,000,000	11,000,000	140,000	41,000,000

[a]Information obtained from the EM-40 Core Database (August 1997). Volume estimates include environmental media such as soil, sediment, sludge, and intermixed rubble/debris; stored wastes; and standing structures and equipment. Sites not listed in this table do not have any radioactively contaminated solid material classified as LLW. The stored waste volumes are also provided separately in Table 6.8.

[b]These volume estimates represent the initial response volumes, not final waste forms. Changes in volumes and waste classes due to treatment are not reflected in this table. All values are preliminary and are being updated as site characterization and engineering studies continue. Values are given to two significant figures or the nearest integer (for volumes less than 10 m^3). Some totals may not equal sum of components due to independent rounding.

[c]Consists of contaminated materials (mostly metal) projected to be recycled.

[d]A listing of the sites being addressed under FUSRAP is given in Fig. 6.3. This program was transferred to the U.S. Army Corps of Engineers in October 1997.

[e]Includes 27,000 m^3 of low-level waste soil in bulk storage at the Middlesex Sampling Plant (see Table 6.8).

[f]Approximately 370,000 t [410,000 tons (or about 200,000 m^3)] of waste has been transferred to the Environmental Restoration Disposal Facility (ERDF) for disposal as of early August 1997.

[g]Consists of Amchitka Island and Project Chariot sites in Alaska, Rio Blanco and Rulison sites in Colorado, the Gnome-Coach and Gasbuggy sites in New Mexico, Salmon Site in Mississippi, and Shoal and Central Nevada Test sites in Nevada. Remedial actions at the Project Chariot Site have been completed.

[h]Consists of East Tennessee Technology Park, Y-12 Plant, Oak Ridge National Laboratory, and contaminated areas in the vicinity of Oak Ridge, Tennessee, beyond the boundaries of these three facilities.

Table 6.4. Projected disposition of radioactively contaminated solid materials classified as MLLW[a]

Site	Response volume,[b] m^3						
	Ex-situ			In-situ treatment/ containment	Access control or no further action	Not yet determined	Total
	Managed by EM-40	Transferred to EM-30	Commercial disposal				
Argonne National Laboratory–East			30	140,000		46	140,000
Battelle Columbus Laboratories		11	20				31
Brookhaven National Laboratory	25		120				150
Fernald Environmental Management Project		1,300	2,400				3,800
Formerly Utilized Sites Remedial Action Program[c]							
New Jersey sites	18,000		5,700				24,000[d]
New York sites			5,100				5,100
General Atomics Site	1		8				9
Hanford Site	220	100					320
Idaho National Engineering and Environmental Laboratory	120,000	120		38,000			160,000
Lawrence Berkeley National Laboratory					42,000		42,000
Los Alamos National Laboratory			980		500,000		500,000
Nevada off-site locations[e]				11,000			11,000
Nevada Test Site	50						50
Oak Ridge Reservation[f]	84,000	8,800					93,000
Paducah Gaseous Diffusion Plant	110	160	330				600
Portsmouth Gaseous Diffusion Plant	330,000	810			170		330,000
Reactive Metals, Inc., Site		9	9				18
Rocky Flats Environmental Technology Site	110,000	8,300		9,900	180,000		310,000
Sandia National Laboratories/New Mexico			1,700		2,600		4,300
Savannah River Site		62,000		410,000		6,400,000[g]	6,900,000
Total	660,000	81,000	16,000	610,000	730,000	6,400,000	8,500,000

[a]Information obtained from the EM-40 Core Database (August 1997). Volume estimates include environmental media such as soil, sediment, sludge, and intermixed rubble/debris; stored wastes; and standing structures and equipment. Sites not listed in this table do not have any radioactively contaminated solid material classified as MLLW. The stored waste volumes are also provided separately in Table 6.8.

[b]These volume estimates represent the initial response volumes, not final waste forms. Changes in volumes and waste classes due to treatment are not reflected in this table. All values are preliminary and are being updated as site characterization and engineering studies continue. Values are given to two significant figures or the nearest integer (for volumes less than 10 m^3). Some totals may not equal sum of components due to independent rounding.

(Footnotes are continued on next page.)

Table 6.4 (continued)

[c]A listing of the sites being addressed under FUSRAP is given in Fig. 6.3. This program was transferred to the U.S. Army Corps of Engineers in October 1997.

[d]Mixed low-level waste soil in bulk storage at the Middlesex Sampling Plant (see Table 6.8).

[e]Consists of Amchitka Island and Project Chariot sites in Alaska, Rio Blanco and Rulison sites in Colorado, the Gnome-Coach and Gasbuggy sites in New Mexico, Salmon Site in Mississippi, and the Shoal and Central Nevada Test sites in Nevada. Remedial actions at the Project Chariot Site have been completed.

[f]Consists of East Tennessee Technology Park, Y-12 Plant, Oak Ridge National Laboratory, and contaminated areas in the vicinity of Oak Ridge, Tennessee, beyond the boundaries of these three facilities.

[g]Most of this material is contaminated soil which will likely be managed in-situ.

Table 6.5. Projected disposition of radioactively contaminated solid materials classified as TRUW[a]

Site	Response volume,[b] m^3					
	Ex-situ		In-situ treatment/ containment	Access control or no further action	Not yet determined	Total
	Managed by EM-40	Transferred to EM-30				
Battelle Columbus Laboratories		370				370
General Electric Vallecitos Nuclear Center	20					20
Hanford Site		1,900				1,900
Idaho National Engineering and Environmental Laboratory[c]		370,000[d]				370,000
Los Alamos National Laboratory			4,400			4,400
Oak Ridge Reservation[e]	28[f]	4				32
Paducah Gaseous Diffusion Plant	1[g]					1
Rocky Flats Environmental Technology Site		4,900[h]				4,900
Sandia National Laboratories/New Mexico				4,000[g]		4,000
Savannah River Site		130,000[i]				130,000
Separations Process Research Unit		36				36
Total	49	510,000	4,400	4,000		520,000

[a]Information obtained from the EM-40 Core Database (August 1997). Volume estimates include environmental media such as soil, sediment, sludge, and intermixed rubble/debris; stored wastes; and standing structures and equipment and include the contribution of material classified as MTRUW. Sites not listed in this table do not have any radioactively contaminated solid material classified as TRUW. The stored waste volumes are provided separately in Table 6.8.

[b]These volume estimates represent the initial response volumes, not final waste forms. Changes in volumes and waste classes due to treatment are not reflected in this table. All values are preliminary and are being updated as site characterization and engineering studies continue. Values are given to two significant figures or the nearest integer (for volumes less than 10 m^3). Some totals may not equal sum of components due to independent rounding.

[c]In addition to TRUW, 1,600 m^3 of HLW-contaminated soil is being addressed at the Idaho Chemical Processing Plant (ICPP).

[d]Soil and debris associated with the Radioactive Waste Management Complex contaminated with transuranic radionuclides. Only a small fraction (on the order of 10,000 m^3) is expected to be managed as TRUW following excavation, sorting, and treatment.

[e]Consists of East Tennessee Technology Park, Y-12 Plant, Oak Ridge National Laboratory, and contaminated areas in the vicinity of Oak Ridge, Tennessee, beyond the boundaries of these three facilities.

[f]At Oak Ridge National Laboratory, 23 m^3 of the TRUW is MTRUW.

[g]MTRUW.

[h]At the Rocky Flats Environmental Technology Site, 4,100 m^3 of the TRUW is MTRUW.

[i]TRUW projected to be generated during decontamination and decommissioning (D&D) activities. The actual volume of TRUW associated with D&D activities will likely be lower than indicated here.

Table 6.6. Projected disposition of radioactively contaminated solid materials classified as 11e(2) by-product material[a,b]

Site	Response volume,[c] m^3						
	Ex-situ			In-situ treatment/ contaminant	Access control or no further action	Not yet determined	Total
	Managed by EM-40	Transferred to EM-30	Commercial disposal				
Fernald Site		11,000[d]					11,000
Formerly Utilized Sites Remedial Action Program[e]							
Missouri sites	19,000		290,000	290,000			600,000[f]
New Jersey sites	110,000		130,000	34,000			270,000[g]
New York sites			84,000	50,000			130,000[h]
Ohio sites			4,600	27,000			31,000
Other sites			770	28,000	770		29,000
Grand Junction Office Site	7,500						7,500
Monticello Mill and Vicinity Properties sites	1,600,000						1,600,000
Uranium Mill Tailings Remedial Action Project[i]	3,200,000						3,200,000
Weldon Spring Site	1,000,000[j]						1,000,000
Total	5,900,000	11,000	510,000	430,000	770		6,900,000

[a]Information obtained from the EM-40 Core Database (August 1997). Volume estimates include environmental media such as soil, sediment, sludge, and intermixed rubble/debris; stored wastes; and standing structures and equipment. Sites not listed in this table do not have any radioactively contaminated solid material classified as 11e(2) by-product material. The stored waste volumes are provided separately in Table 6.8.

[b]By-product material as defined in Section 11e(2) of the Atomic Energy Act of 1954 (Pub. L. 83–703), as amended. Materials being managed under Title 1 of the Uranium Mill Tailings Radiation Control Act of 1978 (Pub. L. 95–604) are defined as residual radioactive material. Since this material has the same physical and radioactive properties as 11e(2) by-product material, it is reported here under 11e(2) by-product material.

[c]These volume estimates represent the initial response volumes, not final waste forms. Changes in volumes and waste classes due to treatment are not reflected in this table. All values are preliminary and are being updated as site characterization and engineering studies continue. Values are given to two significant figures. Some totals may not equal sum of components due to independent rounding.

[d]Residues in storage in four concrete silos (see Table 6.8).

[e]A listing of the sites being addressed under FUSRAP is given in Fig. 6.3. This program was transferred to the U.S. Army Corps of Engineers in October 1997.

[f]Includes 24,000 m^3 of 11e(2) by-product material soil in bulk storage at the Hazelwood Interim Storage Site (see Table 6.8).

[g]Includes 20,000 m^3 of 11e(2) by-product material soil in bulk storage at the Wayne Site (see Table 6.8).

[h]Additional 190,000 m^3 of contaminated soil and residues have been disposed of in a containment cell at the Niagara Falls Storage Site (see Table 6.8).

[i]A listing of the sites being addressed under UMTRAP is given in Fig. 6.2. The volume of mill tailings and debris associated with the 20 sites for which remedial actions have been completed is 27,000,000 m^3 (see Table 6.8).

[j]Includes 700,000 m^3 of 11e(2) by-product material soil and debris in interim storage at the chemical plant area of the Weldon Spring Site (see Table 6.8).

Table 6.7. TSCA mixed waste associated with EM-40 activities[a]

Site	Response volume,[b] m^3	
	RASB[c]	RPCB[d]
Battelle Columbus Laboratories		6[e]
Grand Junction Office Site	65[f]	47[f]
Mound Plant	870[e]	
Oak Ridge Reservation[g]	10,000[h]	700[f]
Paducah Gaseous Diffusion Plant		3,400[f]
Portsmouth Gaseous Diffusion Plant	340[f]	4,300[i]
Reactive Metals, Inc., Site	600[e]	
Separations Process Research Unit	2[e]	
Total	12,000	8,500

[a]Information obtained from the EM-40 Core Database (August 1997). Volume estimates include environmental media such as soil, sediment, sludge, and intermixed rubble/debris; stored wastes; and standing structures and equipment. Sites not listed in this table do not have any radioactively contaminated solid material classified as TSCA mixed wastes. The stored waste volumes are provided separately in Table 6.8.

[b]These volume estimates represent the initial response volumes, not final waste forms. Changes in volumes and waste types due to treatment are not reflected in this table. All values are preliminary and are being updated as site characterization and engineering studies continue. Values are given to two significant figures or the nearest integer (for volumes less than 10 m^3).

[c]Radioactive asbestos (i.e., materials contaminated with both radionuclides and asbestos).

[d]Radioactive PCBs (i.e., materials contaminated with both radionuclides and polychlorinated biphenyls).

[e]Projected to be transferred to a commercial facility for final disposition.

[f]Projected to be managed by EM-40 through final disposition.

[g]Consists of East Tennessee Technology Park, Y-12 Plant, Oak Ridge National Laboratory, and contaminated areas in the vicinity of Oak Ridge, Tennessee, beyond the boundaries of these three facilities.

[h]For the radioactive asbestos (RASB) at the Oak Ridge Reservation, 1,900 m^3 is projected to be managed by EM-40 through final disposition and 8,300 m^3 is projected to be transferred to EM-30 for final disposition.

[i]For the radioactive polychlorinated biphenyl (RPCB) at the Portsmouth Gaseous Diffusion Plant, 3,800 m^3 is projected to be managed by EM-40 through final disposition and 500 m^3 is projected to be transferred to EM-30 for treatment by incineration.

Table 6.8. Volumes (m^3) of solid radioactive wastes in storage at EM-40 facilities[a]

Site	Waste type								
	TRUW	MTRUW	LLW	MLLW[b]	11e(2) by-product material	Mixed 11e(2) by-product material	RASB[c]	RPCB[d]	Total
Battelle Columbus Laboratories	41								41
Fernald Environmental Management Project			140,000	3,500	11,000[e]				150,000
Formerly Utilized Sites Remedial Action Program[f]									
Missouri sites					24,000[g]				24,000
New Jersey sites			27,000[h]	24,000[i]	20,000[j]				71,000
New York sites					190,000[k]				190,000
General Atomics Site			350	3					360
Grand Junction Office Site			6		140	1		47[l]	190
Oak Ridge Reservation[m]				6,900[n]					6,900
Paducah Gaseous Diffusion Plant	1		110,000	580				3,400	110,000
Portsmouth Gaseous Diffusion Plant			13,000	5,400			340	4,300	23,000
Reactive Metals, Inc., Site			640	18			16		670
Uranium Mill Tailings Remedial Action Project					27,000,000[o]				27,000,000
Weldon Spring Site					700,000[p]				700,000

[a]Information obtained from the EM-40 Core Database (August 1997). Waste volumes are limited to solid wastes and do not include EM-40-generated wastes that are currently in storage facilities managed by EM-30. Volumes are given to two significant figures or the nearest integer (for volumes less than 10 m^3). Some totals may not equal sum of components due to independent rounding.

[b]Management plans for these wastes are provided in site treatment plans developed to meet the requirements of the Federal Facility Compliance Act.

[c]Radioactive asbestos, i.e., materials contaminated with both radionuclides and asbestos.

[d]Radioactive PCBs, i.e., materials contaminated with both radionuclides and polychlorinated biphenyls.

[e]11e(2) by-product material residues in storage in four concrete silos.

[f]A listing of sites being addressed under FUSRAP is given in Fig. 6.3. This program was transferred to the U.S. Army Corps of Engineers in October 1997.

[g]11e(2) by-product material soil in bulk storage at the Hazelwood Interim Storage Site. The storage pile is covered with a tarp.

[h]Low-level waste soil in bulk storage at the Middlesex Sampling Plant. The storage pile is covered with a tarp.

[i]Mixed low-level waste soil in bulk storage at the Middlesex Sampling Plant. The storage pile is covered with a tarp. This material has been recently classified as "hazardous waste containing residual radioactive material."

[j]11e(2) by-product material soil in bulk storage at the Wayne Site. The storage pile is covered with a tarp. This material is being removed from the site and transferred to a commercial facility for disposal.

[k]11e(2) by-product material residues and soil disposed of in a containment cell at the Niagara Falls Storage Site.

[l]The radioactive classification of this waste is 11e(2) by-product material.

[m]Consists of East Tennessee Technology Park, Y-12 Plant, Oak Ridge National Laboratory, and contaminated areas in the vicinity of Oak Ridge, Tennessee, beyond the boundaries of these three facilities.

[n]Mixed low-level waste soil and debris in storage at the East Tennessee Technology Park.

[o]Waste volume associated with the 20 completed UMTRAP sites (see Fig. 6.2).

[p]11e(2) by-product material soil and debris in interim storage at the chemical plant area of the Weldon Spring Site.

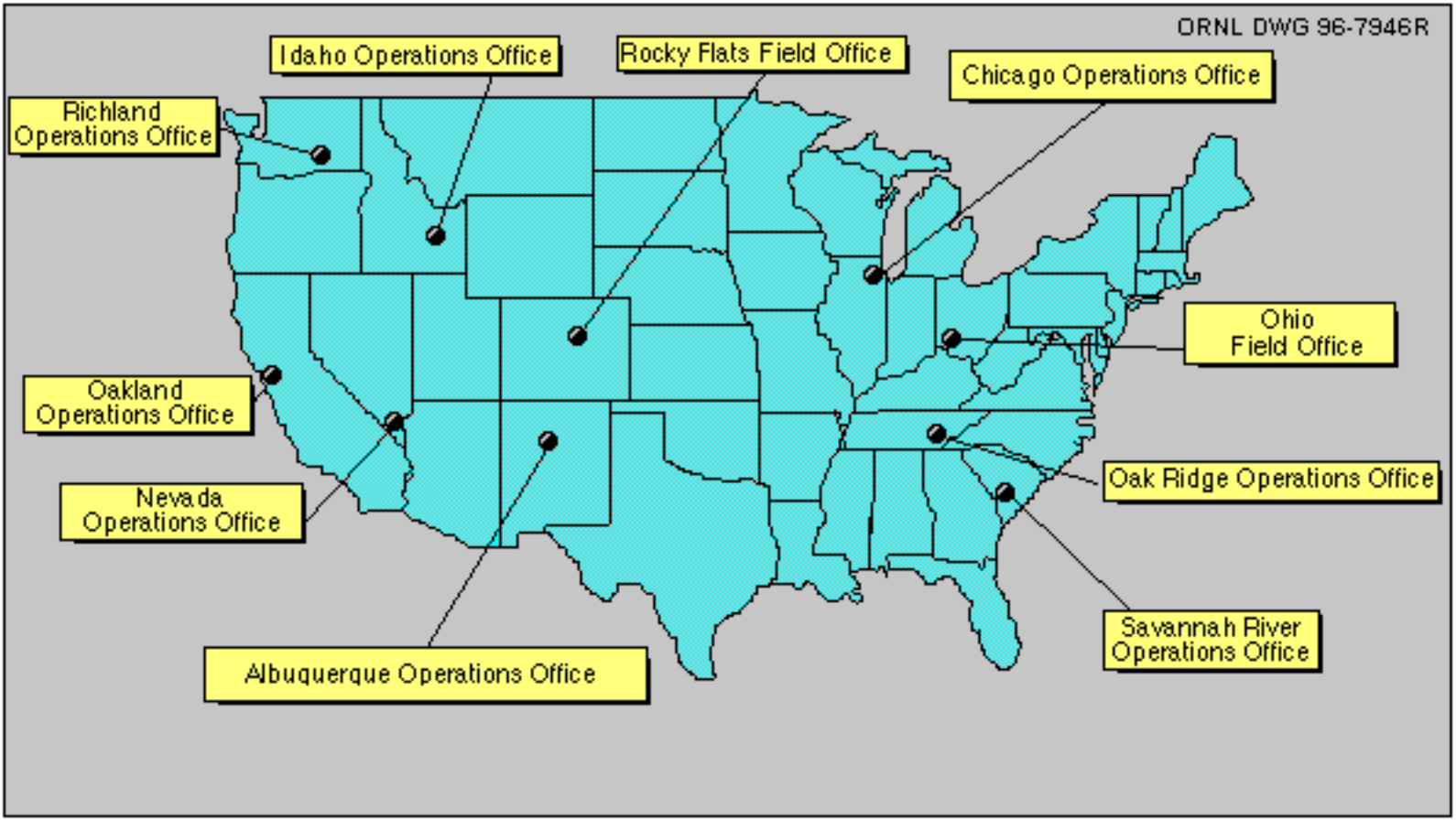

Fig. 6.1. Locations of field offices that direct the DOE environmental restoration program.

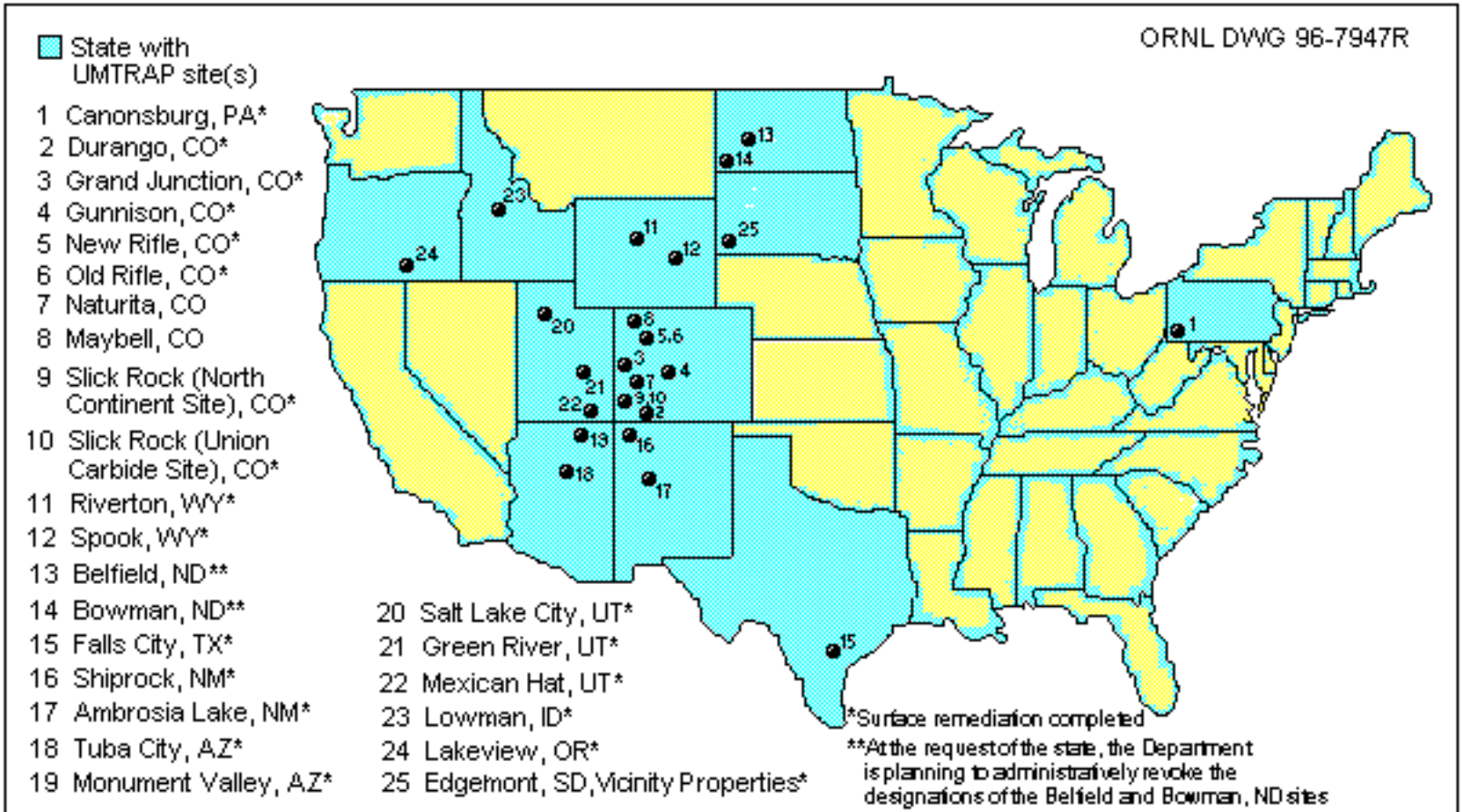

Fig. 6.2. Locations and status of UMTRAP sites.

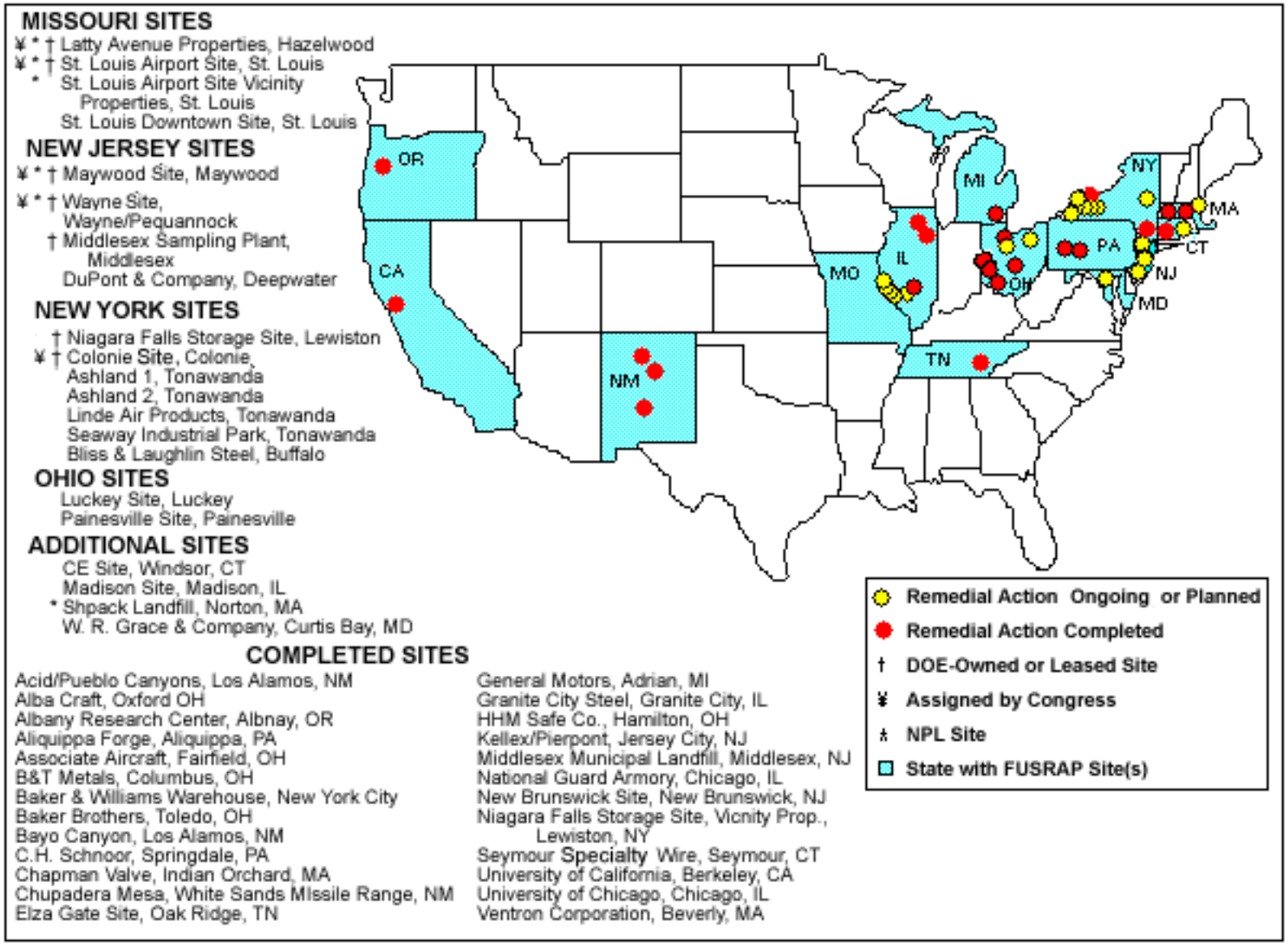

Fig. 6.3. Locations and status of FUSRAP sites.